U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-278 554

Upper and Lower Twin Lakes Kootenai County, Idaho

National Eutrophication Survey, Las Vegas, Nev

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

Jul 77

PB 278 554

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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NATIONAL TECHNICAL
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SPRINGFIELD, VA. 22161

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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REPORT

ON

UPPER AND LOWER TWIN LAKES

KOOTENAI COUNTY

IDAHO

EPA REGION X

WORKING PAPER No. 787

WITH THE COOPERATION OF THE

IDAHO DEPARTMENT OF HEALTH AND WELFARE

AND THE

IDAHO NATIONAL GUARD

JULY, 1977

REPORT ON UPPER AND LOWER TWIN LAKES

KOOTENAI COUNTY, IDAHO

EPA REGION X

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 787

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

July 1977

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TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO. PB278554
4. TITLE AND SUBTITLE Report on Upper and Lower Twin Lakes, Kootenai County, Idaho.		5. REPORT DATE Prepared July 1977 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper No. 787
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency P.O. Box 15027 Las Vegas, NV 89114		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - 1975 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Eutrophication Survey Branch, Corvallis, OR 97330

16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		48G

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release unlimited		49
	20. SECURITY CLASS *(This page)*	22. PRICE PCA03 - A01

EPA Form 2220-1 (9-73)

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Idaho Department of Health and Welfare for professional involvement, to the Idaho National Guard for conducting the tributary sampling phase of the Survey, and to those Idaho wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the State of Idaho Department of Health and Welfare, Division of Environment, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

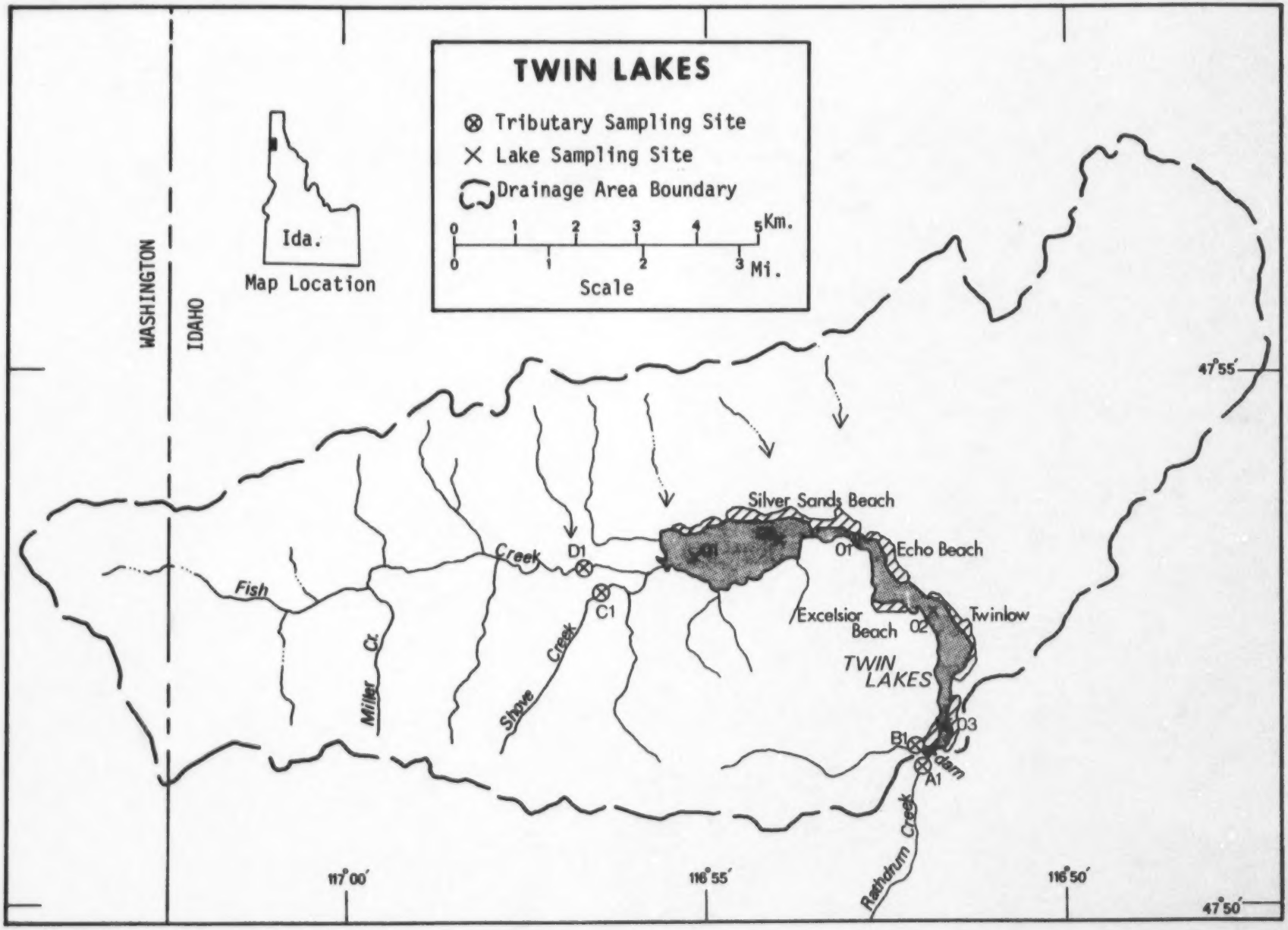
Major General James S. Brooks, Adjutant General of Idaho, and Project Officer Major Vestal L. Baker, who directed the volunteer efforts of the Idaho National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IDAHO

LAKE NAME	COUNTY
American Falls Reservoir	Bannock, Bingham, Power
Cascade Reservoir	Valley
Coeur d'Alene Lake	Benewah, Kootenai
Dworshak Reservoir	Clearwater
Hauser Lake	Kootenai
Hayden Lake	Kootenai
Island Park Reservoir	Fremont
Lake Lowell (Deer Flat Reservoir)	Canyon
Magic Reservoir	Blaine, Camas
Palisades Reservoir	Bonneville (Lincoln in WY)
Payette Lake	Valley
Lower Twin Lake	Kootenai
Upper Twin Lake	Kootenai


TWIN LAKES
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale
Ida.
Map Location
WASHINGTON
IDAHO
47°55'
Silver Sands Beach
Echo Beach
O1
D1
Creek
Fish
C1
Excelsior Beach
O2
Twinlow
TWIN LAKES
Miller Cr.
Shove Creek
D3
B1
dam
A1
Rathdrum Creek
117°00'
116°55'
116°50'
47°50'

REPORT ON UPPER AND LOWER TWIN LAKES, IDAHO

STORET NO.'s 1612-1613

I. CONCLUSIONS

A. Trophic Condition:*

Based upon field observations and Survey data, Twin Lakes is considered eutrophic. Chlorophyll a values in the lake ranged from 1.1 µg/l to 19.4 µg/l with a mean of 2.3 µg/l in the lower basin and 5.0 µg/l in the upper basin. Nutrient levels and potential for primary production as measured by algal assay control yield were low, but aquatic weed problems and algal blooms indicate lake degradation. Secchi disc visibility was quite high in the lake throughout the sampling year.

Field limnologists reported abundant submerged macrophytes along the entire lake bottom; the low phosphorus values in Twin Lakes probably result from phosphorus tied up in these macrophytes. Limnologists also noted algal blooms throughout the lake in July and water lilies in the narrows separating the upper and lower basins. The Idaho Department of Water Resources et al. (1975) report that enriched conditions in Twin Lakes are primarily due to irrigation runoff, feedlots and residential development around the lake.

*See Appendix E.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Upper and Lower Twin Lakes was limited by available phosphorus levels during the sampling year. The lake data generally suggest primary limitation by nitrogen throughout the sampling year.

C. Nutrient Controllability:

1. Point sources -

During the sampling year there were no known point sources impacting Upper and Lower Twin Lakes.

The calculated annual phosphorus loading of 0.12 g $P/m^2/yr$ is equal to that proposed by Vollenweider as a "oligotrophic" loading for lakes with such volume and hydraulic retention time; however, sharp chemical and temperature stratification combined with lengthy detention time could contribute to nutrient buildup and potential for internal recycling. As there are no known avert pollutant sources to the lake, much of the organic load impacting the hypolimnetic dissolved oxygen is presumably from macrophyte decomposition. An aquatic weed control program could be considered for these waters.

Further information about the land uses and watershed surrounding Twin Lakes is needed before additional recommendations for lake improvements can be proposed.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area, mean depth and volume were provided by Martin and Hanson (1966). Maximum depth was estimated on the basis of National Eutrophication Survey (NES) sampling data. Tributary flow data were provided by the Idaho District Office of the U.S. Geological Survey (USGS). Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in NES Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 16.35 km^2.
2. Mean depth: 2.3 meters.
3. Maximum depth: 18.3 meters.
4. Volume: 38.534 x 106 m^3.
5. Mean hydraulic retention time: 676 days (1.8 yr).

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area (km^2)	Mean flow (m^3/sec)
C-1 Shove Creek	6.6	0.11
D-1 Fish Creek	37.8	0.61
Minor tributaries and immediate drainage -	72.4	1.42
Totals	116.8	2.14
2. Outlet - A-1 Rathdrum Creek	133.4	0.66

C. Precipitation:

1. Year of sampling: 86.1 cm.
2. Mean annual: 84.2 cm.

III. LAKE WATER QUALITY SUMMARY

Upper and Lower Twin Lakes was sampled four times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a total of five stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 3.4 meters at Station 01, 17.1 meters at Station 02, and 1.5 meters at Station 03 (Lower Twin Lakes); and 3.4 meters at Station 01, and 4.0 meters at Station 02 (Upper Twin Lakes). For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

STORET CODE 1612

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(6/ 3/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(7/23/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(9/10/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	6	13.7- 15.8	14.9	0.0- 1.5	6	23.9- 25.5	24.6	0.0- 1.5	5	14.3- 15.4	14.5	0.0- 1.5
MAX DEPTH**	3	5.6- 15.5	13.7	1.5- 14.6	3	8.0- 25.3	23.7	1.2- 14.0	3	3.6- 15.4	14.4	0.0- 13.7
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	6	8.8- 9.6	9.0	0.0- 1.5	6	8.2- 9.6	8.7	0.0- 1.5	5	8.6- 9.8	9.0	0.0- 1.5
MAX DEPTH**	3	8.0- 9.0	8.8	1.5- 14.6	3	7.6- 8.8	8.8	1.2- 14.0	3	1.8- 9.8	9.0	0.0- 13.7
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	6	22.- 23.	23.	0.0- 1.5	6	19.- 25.	23.	0.0- 1.5	5	10.- 18.	14.	0.0- 1.5
MAX DEPTH**	3	20.- 23.	23.	1.5- 14.6	3	17.- 25.	22.	1.2- 14.0	3	9.- 18.	14.	0.0- 13.7
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	6	7.3- 8.0	7.8	0.0- 1.5	6	7.0- 7.8	7.3	0.0- 1.5	5	7.5- 8.1	7.8	0.0- 1.5
MAX DEPTH**	3	8.0- 8.2	8.2	1.5- 14.6	3	6.7- 7.4	7.2	1.2- 14.0	3	7.0- 7.9	7.8	0.0- 13.7
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	6	14.- 21.	15.	0.0- 1.5	6	13.- 24.	23.	0.0- 1.5	5	10.- 26.	17.	0.0- 1.5
MAX DEPTH**	3	12.- 21.	18.	1.5- 14.6	3	14.- 23.	18.	1.2- 14.0	3	13.- 25.	15.	0.0- 13.7
TOTAL P (MG/L)												
0.-1.5 M DEPTH	6	0.012-0.018	0.016	0.0- 1.5	6	0.013-0.018	0.015	0.0- 1.5	5	0.012-0.422	0.015	0.0- 1.5
MAX DEPTH**	3	0.012-0.018	0.016	1.5- 14.6	3	0.015-0.022	0.016	1.2- 14.0	3	0.008-0.422	0.014	0.0- 13.7
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	6	0.007-0.014	0.011	0.0- 1.5	6	0.009-0.012	0.009	0.0- 1.5	5	0.002-0.012	0.002	0.0- 1.5
MAX DEPTH**	3	0.007-0.009	0.007	1.5- 14.6	3	0.009-0.012	0.009	1.2- 14.0	3	0.002-0.012	0.002	0.0- 13.7
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	6	0.020-0.020	0.020	0.0- 1.5	6	0.020-0.020	0.020	0.0- 1.5	5	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	3	0.020-0.020	0.020	1.5- 14.6	3	0.020-0.020	0.020	1.2- 14.0	3	0.020-0.020	0.020	0.0- 13.7
AMMONIA (MG/L)												
0.-1.5 M DEPTH	6	0.030-0.040	0.035	0.0- 1.5	6	0.020-0.060	0.035	0.0- 1.5	5	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	3	0.030-0.040	0.040	1.5- 14.6	3	0.020-0.040	0.030	1.2- 14.0	3	0.020-0.020	0.020	0.0- 13.7
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	6	0.200-0.400	0.350	0.0- 1.5	6	0.200-0.800	0.400	0.0- 1.5	5	0.200-1.600	0.400	0.0- 1.5
MAX DEPTH**	3	0.300-0.400	0.300	1.5- 14.6	3	0.200-0.400	0.300	1.2- 14.0	3	0.200-1.600	0.400	0.0- 13.7
SECCHI DISC (METERS)												
	2	3.2- 4.9	4.0		1	3.7- 3.7	3.7		3	1.8- 3.7	3.0	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

LOWER TWIN LAKES
STORET CODE 1612

PHYSICAL AND CHEMICAL CHARACTERISTICS

(10/24/75)

S*** = 3

PARAMETER	N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)				
0.-1.5 M DEPTH	6	9.3- 11.3	10.4	0.0- 1.5
MAX DEPTH**	3	8.1- 10.0	9.3	1.5- 17.1
DISSOLVED OXYGEN (MG/L)				
0.-1.5 M DEPTH	5	8.2- 9.2	8.8	0.0- 1.5
MAX DEPTH**	2	1.4- 9.2	5.3	3.0- 17.1
CONDUCTIVITY (UMHOS)				
0.-1.5 M DEPTH	6	24.- 25.	24.	0.0- 1.5
MAX DEPTH**	3	23.- 32.	24.	1.5- 17.1
PH (STANDARD UNITS)				
0.-1.5 M DEPTH	6	6.7- 7.1	7.0	0.0- 1.5
MAX DEPTH**	3	6.4- 7.1	6.8	1.5- 17.1
TOTAL ALKALINITY (MG/L)				
0.-1.5 M DEPTH	6	10.- 16.	10.	0.0- 1.5
MAX DEPTH**	3	10.- 10.	10.	1.5- 17.1
TOTAL P (MG/L)				
0.-1.5 M DEPTH	6	0.013-0.049	0.016	0.0- 1.5
MAX DEPTH**	3	0.015-0.206	0.020	1.5- 17.1
DISSOLVED ORTHO P (MG/L)				
0.-1.5 M DEPTH	6	0.002-0.018	0.003	0.0- 1.5
MAX DEPTH**	3	0.002-0.149	0.003	1.5- 17.1
NO2+NO3 (MG/L)				
0.-1.5 M DEPTH	6	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	3	0.020-0.020	0.020	1.5- 17.1
AMMONIA (MG/L)				
0.-1.5 M DEPTH	6	0.020-0.030	0.020	0.0- 1.5
MAX DEPTH**	3	0.020-0.280	0.020	1.5- 17.1
KJELDAHL N (MG/L)				
0.-1.5 M DEPTH	6	0.200-0.500	0.200	0.0- 1.5
MAX DEPTH**	3	0.200-0.400	0.400	1.5- 17.1
SECCHI DISC (METERS)				
	3	2.4- 4.0	3.0	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

UPPER TWIN LAKES
STORET CODE 1613

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(6/ 3/75) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(7/23/75) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(9/10/75) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	4	14.6- 15.2	14.9	0.0- 1.5	3	21.5- 22.2	22.0	0.0- 1.5	4	15.1- 16.2	15.7	0.0- 1.5
MAX DEPTH**	2	9.8- 12.4	11.1	3.4- 4.6	2	19.3- 20.4	19.8	2.4- 4.0	2	14.3- 15.1	14.7	2.7- 3.7
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	4	8.8- 10.0	8.9	0.0- 1.5	3	6.8- 9.6	9.2	0.0- 1.5	4	8.6- 9.6	9.4	0.0- 1.5
MAX DEPTH**	2	8.8- 9.2	9.0	3.4- 4.6	2	9.8- 10.2	10.0	2.4- 4.0	2	9.6- 9.6	9.6	2.7- 3.7
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	4	20.- 22.	22.	0.0- 1.5	3	14.- 22.	21.	0.0- 1.5	4	14.- 19.	16.	0.0- 1.5
MAX DEPTH**	2	18.- 20.	19.	3.4- 4.6	2	19.- 21.	20.	2.4- 4.0	2	16.- 16.	16.	2.7- 3.7
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	4	7.4- 8.0	7.8	0.0- 1.5	3	7.6- 8.0	7.8	0.0- 1.5	4	7.6- 8.5	8.3	0.0- 1.5
MAX DEPTH**	2	7.7- 7.7	7.7	3.4- 4.6	2	7.8- 8.7	8.3	2.4- 4.0	2	8.3- 8.3	8.3	2.7- 3.7
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	4	10.- 17.	15.	0.0- 1.5	3	19.- 21.	20.	0.0- 1.5	4	12.- 14.	13.	0.0- 1.5
MAX DEPTH**	2	10.- 15.	13.	3.4- 4.6	2	19.- 22.	21.	2.4- 4.0	2	11.- 16.	14.	2.7- 3.7
TOTAL P (MG/L)												
0.-1.5 M DEPTH	4	0.016-0.019	0.017	0.0- 1.5	3	0.014-0.015	0.014	0.0- 1.5	4	0.016-0.024	0.020	0.0- 1.5
MAX DEPTH**	2	0.016-0.018	0.017	3.4- 4.6	2	0.015-0.021	0.018	2.4- 4.0	2	0.016-0.069	0.042	2.7- 3.7
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	4	0.007-0.017	0.013	0.0- 1.5	3	0.004-0.011	0.009	0.0- 1.5	4	0.002-0.003	0.002	0.0- 1.5
MAX DEPTH**	2	0.012-0.014	0.013	3.4- 4.6	2	0.009-0.014	0.011	2.4- 4.0	2	0.002-0.002	0.002	2.7- 3.7
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	4	0.020-0.020	0.020	0.0- 1.5	3	0.020-0.020	0.020	0.0- 1.5	4	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	2	0.020-0.020	0.020	3.4- 4.6	2	0.020-0.020	0.020	2.4- 4.0	2	0.020-0.020	0.020	2.7- 3.7
AMMONIA (MG/L)												
0.-1.5 M DEPTH	4	0.040-0.100	0.045	0.0- 1.5	3	0.040-0.060	0.040	0.0- 1.5	4	0.020-0.030	0.020	0.0- 1.5
MAX DEPTH**	2	0.030-0.040	0.035	3.4- 4.6	2	0.020-0.040	0.030	2.4- 4.0	2	0.020-0.020	0.020	2.7- 3.7
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	4	0.400-0.600	0.400	0.0- 1.5	3	0.400-0.600	0.600	0.0- 1.5	4	0.400-0.400	0.400	0.0- 1.5
MAX DEPTH**	2	0.300-0.300	0.300	3.4- 4.6	2	0.300-0.400	0.350	2.4- 4.0	2	0.400-0.600	0.500	2.7- 3.7
SECCHI DISC (METERS)												
	2	3.0- 3.2	3.1		1	4.6- 4.6	4.6		2	2.4- 3.7	3.0	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

UPPER TWIN LAKES
STORET CODE 1613

PHYSICAL AND CHEMICAL CHARACTERISTICS

(10/24/75)

S*** = 2

PARAMETER	N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)				
0.-1.5 M DEPTH	4	8.8- 10.1	9.6	0.0- 1.5
MAX DEPTH**	2	8.8- 9.9	9.3	1.5- 3.0
DISSOLVED OXYGEN (MG/L)				
0.-1.5 M DEPTH	4	9.4- 10.0	9.7	0.0- 1.5
MAX DEPTH**	2	9.4- 9.8	9.6	1.5- 3.0
CONDUCTIVITY (UMHOS)				
0.-1.5 M DEPTH	4	20.- 24.	22.	0.0- 1.5
MAX DEPTH**	2	20.- 24.	22.	1.5- 3.0
PH (STANDARD UNITS)				
0.-1.5 M DEPTH	4	6.9- 7.3	7.1	0.0- 1.5
MAX DEPTH**	2	7.0- 7.3	7.1	1.5- 3.0
TOTAL ALKALINITY (MG/L)				
0.-1.5 M DEPTH	4	10.- 18.	10.	0.0- 1.5
MAX DEPTH**	2	10.- 18.	14.	1.5- 3.0
TOTAL P (MG/L)				
0.-1.5 M DEPTH	4	0.014-0.019	0.016	0.0- 1.5
MAX DEPTH**	2	0.018-0.019	0.018	1.5- 3.0
DISSOLVED ORTHO P (MG/L)				
0.-1.5 M DEPTH	4	0.002-0.005	0.002	0.0- 1.5
MAX DEPTH**	2	0.002-0.005	0.003	1.5- 3.0
NO2+NO3 (MG/L)				
0.-1.5 M DEPTH	4	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	2	0.020-0.020	0.020	1.5- 3.0
AMMONIA (MG/L)				
0.-1.5 M DEPTH	4	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	2	0.020-0.020	0.020	1.5- 3.0
KJELDAHL N (MG/L)				
0.-1.5 M DEPTH	4	0.200-0.400	0.300	0.0- 1.5
MAX DEPTH**	2	0.200-0.300	0.250	1.5- 3.0
SECCHI DISC (METERS)	2	3.1- 3.2	3.2	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton - Lower Twin Lakes

Sampling Date	Dominant Genera	Algal Units per ml
06/03/75	1. Dinobryon	1,214
	2. Asterionella	187
	3. Flagellate	140
	4. Anabaena	47
	5. Nitzschia	47
	Other genera	45
	Total	1,680
07/23/75	1. Melosira	875
	2. Fragilaria	175
	3. Ankistrodesmus	131
	4. Asterionella	87
	5. Chlorophytan cell	87
	Other genera	176
	Total	1,531
09/10/75	1. Merismopedia	3,081
	2. Chroomonas	171
	3. Melosira	171
	4. Cryptomonas	128
	5. Oocystis	86
	Other genera	129
	Total	3,766
10/24/75	1. Ankistrodesmus	128
	2. Cryptomonas	128
	3. Chroomonas	43
	4. Tabellaria	43
	Other genera	---
	Total	342

B. Biological Characteristics: (continued)

1. Phytoplankton - Upper Twin Lakes

Sampling Date	Dominant Genera	Algal Units per ml
06/03/75	1. Dinobryon	788
	2. Chroomonas	338
	3. Ankistrodesmus	113
	4. Asterionella	113
	5. Cryptomonas	113
	Other genera	167
	Total	1,632
07/23/75	1. Cryptomonas	291
	2. Chroomonas	97
	3. Stichococcus	97
	4. Chroococcus	48
	5. Coelosphaerium	48
	Other genera	---
	Total	581
09/10/75	1. Melosira	932
	2. Fragilaria	883
	3. Epithemia	343
	4. Lyngbya	294
	5. Ankistrodesmus	196
	Other genera	1,769
	Total	4,417
10/24/75	1. Flagellate	1,200
	2. Cryptomonas	768
	3. Chroomonas	432
	4. Chlamydomonas	144
	5. Mallomonas	144
	Other genera	47
	Total	2,735

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
06/03/75	01 (Lower Twin)	1.7
	02	1.1
	03	1.2
	01 (Upper Twin)	2.5
	02	2.4
07/23/75	01	2.9
	02	3.7
	03	2.0
	01	1.9
	02	3.4
09/10/75	01	3.7
	02	2.5
	03	---
	01	19.4
	02	----
10/24/75	01	2.8
	02	2.5
	03	1.4
	01	2.5
	02	2.8

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 06/03/75 (Lower Twin Lakes)

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	<0.005	0.025	0.4
0.05 P	<0.055	0.025	1.4
0.05 P + 1.0 N	<0.055	1.025	17.4
1.00 N	<0.005	1.025	0.5

b. 09/10/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.010	0.035	0.9
0.05 P	0.060	0.035	5.6
0.05 P + 1.0 N	0.060	1.035	18.8
1.00 N	0.010	1.035	0.8

c. 10/24/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.010	0.050	0.7
0.05 P	0.060	0.050	3.9
0.05 P + 1.0 N	0.060	1.050	21.2
1.00 N	0.010	1.050	0.7

C. Limiting Nutrient Study (continued) -

1. Autoclaved, filtered, and nutrient spiked -

d. 06/03/75 (Upper Twin Lakes)

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	<0.005	0.025	0.3
0.05 P	<0.055	0.025	1.7
0.05 P + 1.0 N	<0.055	1.025	17.6
1.00 N	<0.005	1.025	0.3

e. 09/10/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.025	0.150	2.1
0.05 P	0.075	0.150	9.0
0.05 P + 1.0 N	0.075	1.150	24.4
1.00 N	0.025	1.150	2.1

f. 10/24/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.005	0.045	0.6
0.05 P	0.055	0.045	4.0
0.05 P + 1.0 N	0.055	1.045	25.6
1.00 N	0.005	1.045	0.5

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential for primary productivity was moderate in Upper and Lower Twin Lakes except during September sampling when it was high in Upper Twin Lakes. In all assays, there was significant increase in yield over that of the control when orthophosphorus was added indicating phosphorus limitation. The addition of nitrogen alone did not result in an increase in yield, and the maximum growth increase over that of the control was achieved with the simultaneous addition of both nitrogen and phosphorus.

Mean inorganic nitrogen to orthophosphorus ratios N/P in the lake data were approximately 6/1 in Lower Twin Lakes for all sampling rounds suggesting nitrogen limitation at those times. In Upper Twin Lakes, the N/P ratios of approximately 5/1 and 6/1 in June and August suggest nitrogen limitation, while the approximate ratios of 21/1 and 13/1 in September and October suggest phosphorus limitation and co-limitation by the two nutrients, respectively, on those sampling occasions.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Idaho National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of July when two samples were collected. Sampling was begun in October 1974, and was completed in September 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Idaho District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/year$, in Shove Creek and Fish Creek at Stations C-1 and D-1 and multiplying the means by the ZZ area in km^2.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Shove Creek	55	2.9
D-1 Fish Creek	580	30.4
b. Minor tributaries and immediate drainage (nonpoint load) -	870	45.5
c. Known municipal STP's - None		
d. Septic tanks* -	120	6.3
e. Known industrial - None		
f. Direct precipitation** -	285	14.9
Totals	1,910	100.0%

2. Outputs - A-1 Rathdrum Creek 235

3. Net annual P accumulation - 1,675

*Estimate based on 419 lakeshore residences.
**Estimated (See NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Shove Creek	1,970	3.8
D-1 Fish Creek	8,590	16.6
b. Minor tributaries and immediate drainage (nonpoint load) -	18,970	36.8
c. Known municipal STP's - None		
d. Septic tanks* -	4,465	8.6
e. Known industrial - None		
f. Direct precipitation** -	17,650	34.2
Totals	51,645	100.0%

2. Outputs - A-1 Rathdrum Creek 7,610

3. Net annual N accumulation - 44,035

*Estimate based on 419 lakeshore residences.
**Estimated (See NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Shove Creek	8	298
Fish Creek	15	227

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
B-1 Unnamed Stream	0.037	0.570

E. Yearly Loadings:

In the following table, the existing phosphorus loading is compared to the realtionship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "dangerous" and "permissible."

Note that Vollenweider's model may not be applicable to water bodies with very short retention times or in which light penetration is severely restricted from high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Upper and Lower Twin Lakes	0.12
Vollenweider's "eutrophic" loading	0.22
Vollenweider's "oligotrophic" loading	0.11

V. LITERATURE REVIEWED

Idaho Department of Water Resources, Department of Health and Welfare, Department of Fish and Game, and Department of Budget, Policy Planning and Coordination. 1975. Idaho Environmental Overview. Boise, Idaho.

Martin, R.O.R. and Ronald L. Hanson, 1966. Reservoirs in the U.S. Geological Survey Water Supply Paper 1838. U.S. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IDAHO 08/23/76

LAKE CODE 1612 TWIN LAKES

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 133.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1612A1	133.4	0.57	0.74	0.96	1.70	1.13	0.68	0.68	0.62	0.31	0.11	0.17	0.31	0.66
1612C1	6.6	0.113	0.142	0.255	0.283	0.198	0.085	0.028	0.028	0.028	0.028	0.028	0.057	0.106
161201	37.8	0.57	0.88	1.39	1.56	1.19	0.48	0.23	0.14	0.14	0.17	0.23	0.34	0.61
161277	88.8	1.42	1.98	3.34	3.71	2.72	1.13	0.45	0.37	0.37	0.40	0.45	0.79	1.42

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 133.4
SUM OF SUB-DRAINAGE AREAS = 133.3

TOTAL FLOW IN = 25.71
TOTAL FLOW OUT = 7.99

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1612A1	10	74	0.072	19	0.071				
	11	74	0.113	18	0.113				
	12	74	0.196	16	0.130				
	1	75	0.507	18	0.580				
	2	75	0.906	16	0.510				
	3	75	1.356	16	0.864				
	4	75	1.484	13	0.255				
	5	75	4.332	16	5.097				
	6	75	0.988	7	1.416				
	7	75	0.467	5	0.566	8	0.566	28	0.425
	8	75	0.368	8	0.396				
	9	75	0.230						
1612C1	10	74	0.017	19	0.017				
	11	74	0.028	18	0.037				
	12	74	0.028	16	0.023				
	1	75	0.037	18	0.079				
	2	75	0.051	16	0.062				
	3	75	0.133	16	0.108				
	4	75	0.261	13	0.156				
	5	75	0.368	16	0.481				
	6	75	0.122	7	0.150				
	7	75	0.048	5	0.057	8	0.051	28	0.037
	8	75	0.031	8	0.028				
	9	75	0.025						

TRIBUTARY FLOW INFORMATION FOR IDAHO 08/23/76

LAKE CODE 1612 TWIN LAKES

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
161201	10	74	0.105	19	0.099				
	11	74	0.159	18	0.210				
	12	74	0.164	16	0.136				
	1	75	0.210	18	0.453				
	2	75	0.283	16	0.368				
	3	75	0.765	16	0.623				
	4	75	1.472	13	0.906				
	5	75	2.124	16	2.718				
	6	75	0.680	7	0.850				
	7	75	0.278	5	0.311	8	0.283	28	0.210
	8	75	0.173	8	0.161				
	9	75	0.142						

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

161201
47 53 27.0 116 53 00.0 3
LOWER TWIN LAKES
16055 IDAHO

130292

11EPALES 2111202
0015 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/03	12 15	0000	15.8	9.0	126	22	7.80	14	0.040	0.400	0.020K	0.012
	12 15	0005	15.7	9.0		22	7.90	14	0.030	0.400	0.020K	0.011
	12 15	0011	15.5	9.0		23	8.20	12	0.040	0.400	0.020K	0.007
75/07/23	13 15	0000	24.2	8.6	144	25	7.05	24	0.060	0.800	0.020K	0.012
	13 15	0005	23.9	8.8		21	7.20	24	0.040	0.400	0.020K	0.009
	13 15	0010	23.7	7.6		22	7.20	23	0.020	0.400	0.020K	0.009
75/09/10	14 30	0000	14.5	9.0	144	14	8.15	26	0.020K	0.500	0.020K	0.004
	14 30	0005	14.3	9.0		14	7.70	10	0.020K	0.400	0.020K	0.002
	14 30	0009	14.4	9.0		14	7.80	13	0.020K	0.400	0.020K	0.007
75/10/24	10 30	0000	10.4	9.0	156	24	6.70	16	0.030	0.500	0.020K	0.018
	10 30	0005	10.4	8.8		24	6.70	10K	0.020K	0.400	0.020K	0.006
	10 30	0010	10.0	9.2		23	6.80	10K	0.020K	0.400	0.020K	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/06/03	12 15	0000	0.016	1.7	
	12 15	0005	0.017		
	12 15	0011	0.016		
75/07/23	13 15	0000	0.018	2.9	
	13 15	0005	0.015		
	13 15	0010	0.015		
75/09/10	14 30	0000	0.034	3.7	
	14 30	0005	0.015		
	14 30	0009	0.014		
75/10/24	10 30	0000	0.030	2.8	
	10 30	0005	0.049		
	10 30	0010	0.020		

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

161202
47 52 44.0 116 51 59.0 3
LOWER TWIN LAKES
16055 IDAHO

130292

11EPALES 2111202
0052 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/03	12 35	0000	15.0	8.8	192	22	7.30	14	0.030	0.200	0.020K	0.011
	12 35	0005	14.9	9.0		23	7.50	16	0.040	0.300	0.020K	0.014
	12 35	0015	14.1	9.0		22	7.70	17	0.030	0.300	0.020K	0.011
	12 35	0025	7.0	8.0		19	7.70	15	0.030	0.300	0.020K	0.009
	12 35	0048	5.6	8.0		20	8.20	18	0.030	0.300	0.020K	0.009
75/07/23	13 35	0000	25.0	9.6		20	7.80	24	0.030	0.500	0.020K	0.009
	13 35	0005	24.2	8.6		19	7.30	22	0.020	0.200	0.020K	0.009
	13 35	0015	22.6	9.4		17	7.20	24	0.030	0.200K	0.020K	0.010
	13 35	0030	10.6	5.8		12	6.40	16	0.090	0.400	0.030	0.020
	13 35	0046	8.0	8.8		17	6.70	18	0.040	0.200K	0.020	0.012
75/09/10	11 40	0000	14.7	8.6	120	14	7.80	17	0.020K	0.200K	0.020K	0.002
	11 40	0005	14.4	8.6		10	7.50	16	0.020K	0.200K	0.020K	0.002K
	11 40	0020	12.3	8.4		8	7.30	15	0.020K	0.200	0.020K	0.005
	11 40	0030	6.4	1.8		8	6.80	16	0.020	0.200	0.020K	0.006
	11 40	0045	3.6	1.8		9	7.05	15	0.020K	0.200	0.020K	0.002
75/10/24	09 50	0000	11.3	8.2	120	25	7.00	10K	0.020K	0.200	0.020K	0.003
	09 50	0005	11.2	8.2		24	7.00	10K	0.020K	0.200K	0.020K	0.004
	09 50	0016	11.2	8.6		24	6.90	10K	0.020K	0.200K	0.020K	0.004
	09 50	0040	10.9	7.6		24	6.70	10K	0.020K	0.200K	0.020K	0.010
	09 50	0056	8.1	1.4		32	6.45	10	0.280	0.400	0.020K	0.149

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/06/03	12 35	0000	0.012	1.1	
	12 35	0005	0.016		
	12 35	0015	0.013		
	12 35	0025	0.012		
	12 35	0048	0.012		
75/07/23	13 35	0000	0.013	3.7	
	13 35	0005	0.013		
	13 35	0015	0.015		
	13 35	0030	0.024		
	13 35	0046	0.022		
75/09/10	11 40	0000	0.012	2.5	
	11 40	0005	0.014		
	11 40	0020	0.027		
	11 40	0030	0.015		
	11 40	0045	0.008		
75/10/24	09 50	0000	0.015	2.5	
	09 50	0005	0.017		
	09 50	0016	0.017		
	09 50	0040	0.027		

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

161203
47 51 38.0 116 51 54.0 3
LOWER TWIN LAKES
16055 IDAHO

130391

11EPALES 2111202
0008 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/03	13 00	0000	14.7	9.6		23	8.00	17	0.030	0.400	0.020K	0.010
	13 00	0005	13.7	8.8		23	8.00	21	0.040	0.300	0.020K	0.007
75/07/23	13 55	0000	25.5	8.2		25	7.40	13	0.050	0.400	0.020K	0.010
	13 55	0004	25.3	8.8		25	7.40	14	0.030	0.300	0.020K	0.009
75/09/10	14 15	0000	15.4	9.8	72	18	7.90	25	0.020	1.600	0.020K	0.012
75/10/24	09 30	0000	9.3	9.2	96	24	7.10	10	0.020K	0.200K	0.020K	0.003
	09 30	0005	9.3			24	7.10	10K	0.020K	0.200K	0.020K	0.002

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/03	13 00	0000	0.016	1.2	
	13 00	0005	0.018		
75/07/23	13 55	0000	0.016	2.0	
	13 55	0004	0.016		
75/09/10	14 15	0000	0.422		
75/10/24	09 30	0000	0.013	1.4	
	09 30	0005	0.015		

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

161301
47 53 15.0 116 55 10.0 3
UPPER TWIN LAKES
16055 IDAHO

130292

11EPALES 2111202
0015 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/03	11 30	0000	14.7	8.8	120	22	7.70	17	0.100	0.400	0.020K	0.013
	11 30	0005	14.6	8.8		21	7.40	12	0.040	0.400	0.020K	0.017
	11 30	0011	12.4	9.2		20	7.70	10K	0.040	0.300	0.020K	0.014
75/07/23	11 15	0000	21.5	9.6		22	8.00	20	0.060	0.600	0.020K	0.011
	11 15	0008	20.4	10.2		21	7.85	19	0.020	0.400	0.020K	0.009
75/09/10	15 15	0000	16.2	9.4	144	16	8.35	14	0.030	0.400	0.020K	0.003
	15 15	0005	15.9	8.6		15	8.50	12	0.020K	0.400	0.020K	0.002
	15 15	0009	14.3	9.6		16	8.30	16	0.020K	0.400	0.020K	0.002K
75/10/24	12 05	0000	9.2	10.0	126	23	7.30	10	0.020K	0.300	0.020K	0.002K
	12 05	0005	8.8	9.8		24	7.30	18	0.020K	0.200K	0.020K	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/06/03	11 30	0000	0.016	2.5	
	11 30	0005	0.019		
	11 30	0011	0.018		
75/07/23	11 15	0000	0.014	1.9	
	11 15	0008	0.015		
75/09/10	15 15	0000	0.016	19.4	
	15 15	0005	0.019		
	15 15	0009	0.016		
75/10/24	12 05	0000	0.018	2.5	
	12 05	0005	0.019		

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

161302
47 53 28.0 116 54 02.0 3
UPPER TWIN LAKES
16055 IDAHO

130292

11EPALES 2111202
0019 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/03	11 55	0000	15.2	10.0	126	20	8.00	10K	0.040	0.600	0.020K	0.014
	11 55	0005	15.2	9.0		22	7.90	17	0.050	0.400	0.020K	0.007
	11 55	0015	9.8	8.8		18	7.70	15	0.030	0.300	0.020K	0.012
75/07/23	11 30	0000	22.2	6.8	180	21	7.60	19	0.040	0.600	0.020K	0.004
	11 30	0005	22.0	9.2		14	7.80	21	0.040	0.400	0.020K	0.009
	11 30	0013	19.3	9.8		19	8.70	22	0.040	0.300	0.020K	0.014
75/09/10	14 45	0000	15.5	9.4	96	14	7.60	13	0.020K	0.400	0.020K	0.002K
	14 45	0005	15.1	9.6		19	8.20	13	0.020K	0.400	0.020K	0.003
	14 45	0012	15.1	9.6		16	8.30	11	0.020K	0.600	0.020K	0.002
75/10/24	11 45	0000	10.1	9.4	124	20	6.90	10K	0.020K	0.400	0.020K	0.003
	11 45	0005	10.0	9.6		21	7.00	10K	0.020K	0.300	0.020K	0.002
	11 45	0010	9.9	9.4		20	7.00	10K	0.020K	0.300	0.020K	0.002

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/06/03	11 55	0000	0.018	2.4	
	11 55	0005	0.017		
	11 55	0015	0.016		
75/07/23	11 30	0000	0.015	3.4	
	11 30	0005	0.014		
	11 30	0013	0.021		
75/09/10	14 45	0000	0.024		
	14 45	0005	0.022		
	14 45	0012	0.069		
75/10/24	11 45	0000	0.014	2.8	
	11 45	0005	0.015		
	11 45	0010	0.018		

K VALUE KNOWN TO BE LESS THAN INDICATED

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

161241
47 51 25.0 116 51 58.0 4
RATHDRUM CREEK
16 7.5 HAYDEN
O/TWIN LAKES 130391
GRVL RD BRDG 2.3 MI SW OF TWIN LKS STATN
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19	13 50		0.024	0.200	0.055	0.005K	0.010
74/11/18	10 45		0.024	0.100K	0.061	0.005K	0.010K
74/12/16	10 30		0.040	0.200	0.015	0.005	0.010
75/01/18	13 15		0.032	0.200	0.025	0.005K	0.010K
75/02/16	14 05		0.040	0.800	0.044	0.008	0.010K
75/03/16	10 20		0.035	0.200	0.015	0.005K	0.010K
75/04/13	11 30		0.070	0.150	0.010	0.005K	0.010K
75/05/16	14 30		0.010	0.300	0.030	0.005K	0.010K
75/06/07	11 45		0.010	0.250	0.020	0.005K	0.010
75/07/05	10 30		0.005	0.400	0.015	0.005	0.010K
75/07/08	11 05		0.010	0.900	0.015	0.005K	0.010
75/07/28	11 00		0.005	0.400	0.010	0.005K	0.030
75/08/08	09 00		0.025	0.250	0.040	0.010	0.040
75/09/10	11 40		0.010	0.900	0.020	0.005K	0.010K

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

1612B1
47 51 27.0 116 51 59.0 4
UNNAMED STREAM
16 7.5 HAYDEN
T/TWIN LAKES 130391
GRVL RD BRDG 2.4 MI SW OF TWIN LKS STATN
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19			0.016	0.900	0.030	0.005	0.010
74/11/18	11 00		0.128	0.700	0.030	0.025	
74/12/18	10 45		0.336	0.300	0.015	0.010	0.010
75/03/16	10 15		0.375	0.200	0.025	0.005K	0.040
75/04/13	11 40		0.575	0.600	0.035	0.005K	0.020
75/05/16	14 45		0.210	0.500	0.035	0.005	0.080
75/06/07	12 05		0.070	0.250	0.055	0.020	0.060
75/07/05	10 50		0.065	0.150	0.005	0.005K	0.020
75/07/08	11 20		0.105	0.200	0.030	0.005	0.040
75/07/28	11 20		0.110	0.300	0.015	0.015	0.040
75/08/08	09 15		0.080	0.400	0.020	0.010	0.060
75/09/10	11 55		0.065	0.200	0.015	0.005	0.030

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

1612C1
47 52 48.0 116 56 43.0 4
SHOVE CREEK
16 7.5 SPIRIT LK W
T/TWIN LAKES 130292
GRVL RD BRDG 4.2 MI WSW OF SLVR SNDS RCH
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19	14	55	0.016	0.300	0.025	0.015	0.025
74/11/18	11	40	0.032	0.200	0.025	0.020	0.040
74/12/16	11	30	0.016	0.200	0.025	0.015	0.020
75/04/13	12	20	0.025	0.250	0.020	0.015	0.015
75/05/16	15	30	0.030	1.450	0.065	0.010	0.010
75/06/07	13	15	0.010	0.700	0.020	0.010	0.010
75/07/05	11	50	0.005	0.100	0.005K	0.015	0.020
75/07/08	13	00	0.010	0.050K	0.005	0.015	0.020
75/07/28	12	10	0.015	0.550	0.010	0.020	0.030
75/08/08			0.010	0.075	0.010	0.020	0.045
75/09/10	12	30	0.015	3.000	0.040	0.015	0.020

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/08/25
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

1612D1
47 53 09.0 116 57 06.0 4
FISH CREEK
16 7.5 SPIRIT LK W
T/TWIN LAKES 130292
GRVL RD BRDG 3.8 MI W OF SILVER SNDS RCH
11EPALES 2111204
0090 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19	14 40		0.016	0.100	0.010	0.015	0.025
74/11/18	11 30		0.048	0.400	0.025	0.020	0.050
74/12/16	11 04		0.040	0.400	0.025	0.015	0.020
75/01/18	14 00		0.080	0.200	0.015	0.015	0.040
75/02/16	14 30		0.056	0.800	0.024	0.016	0.016
75/03/16	11 00		0.055	0.150	0.010	0.010	0.020
75/04/13	12 10		0.080	0.100	0.015	0.010	0.030
75/05/16	15 15		0.035	0.800	0.055	0.025	0.040
75/06/07	13 00		0.020	0.350	0.010	0.010	0.030
75/07/05	11 30		0.010	1.350	0.027	0.015	0.030
75/07/08	12 50		0.020	0.350	0.015	0.015	0.035
75/07/28	11 55		0.020	0.150	0.010	0.015	0.020
75/08/08	09 45		0.010	0.150	0.020	0.020	0.050
75/09/10	12 50		0.020	2.000	0.030	0.015	0.020

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APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1975

STATE OF IDAHO

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of Idaho lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in µg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1601	AMERICAN FALLS RESERVOIR	0.105	0.080	463.800	15.379	14.700	0.035
1602	CASCADE LAKE	0.032	0.060	415.067	8.081	14.800	0.009
1603	LAKE COEUR D'ALENE	0.017	0.040	380.348	10.391	12.200	0.005
1604	DWORSHAK RESERVOIR	0.010	0.080	401.866	2.420	7.400	0.009
1605	HAUSER	0.028	0.075	366.286	11.112	14.800	0.013
1606	HAYDEN LAKE	0.010	0.040	243.500	2.787	11.800	0.003
1607	ISLAND PARK RESERVOIR	0.034	0.050	391.778	9.322	12.800	0.012
1608	LAKE LOWELL	0.070	0.070	477.111	25.389	14.600	0.015
1609	MAGIC RESERVOIR	0.062	0.130	400.750	7.322	14.700	0.020
1610	PALISADES RESERVOIR	0.024	0.080	345.428	2.067	12.800	0.007
1611	LOWER PAYETTE	0.013	0.060	234.000	4.600	9.600	0.007
1612	LOWER TWIN LAKES	0.016	0.050	370.000	2.318	13.600	0.009
1613	UPPER TWIN LAKES	0.017	0.045	369.143	4.986	8.200	0.004

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1601	AMERICAN FALLS RESERVOIR	0 (0)	17 (1)	8 (1)	8 (1)	21 (2)	0 (0)
1602	CASCADE LAKE	33 (4)	54 (6)	17 (2)	42 (5)	4 (0)	50 (5)
1603	LAKE COEUR D'ALENE	67 (8)	96 (11)	50 (6)	25 (3)	67 (8)	83 (10)
1604	DWORSHAK RESERVOIR	96 (11)	17 (1)	25 (3)	83 (10)	100 (12)	50 (5)
1605	HAUSER	42 (5)	33 (4)	75 (9)	17 (2)	4 (0)	25 (3)
1606	HAYDEN LAKE	96 (11)	96 (11)	92 (11)	75 (9)	75 (9)	100 (12)
1607	ISLAND PARK RESERVOIR	25 (3)	71 (8)	42 (5)	33 (4)	54 (6)	33 (4)
1608	LAKE LOWELL	8 (1)	42 (5)	0 (0)	0 (0)	33 (4)	17 (2)
1609	MAGIC RESERVOIR	17 (2)	0 (0)	33 (4)	50 (6)	21 (2)	8 (1)
1610	PALISADES RESERVOIR	50 (6)	17 (1)	83 (10)	100 (12)	54 (6)	75 (9)
1611	LOWER PAYETTE	83 (10)	54 (6)	100 (12)	67 (8)	83 (10)	67 (8)
1612	LOWER TWIN LAKES	75 (9)	71 (8)	58 (7)	92 (11)	42 (5)	50 (5)
1613	UPPER TWIN LAKES	58 (7)	83 (10)	67 (8)	58 (7)	92 (11)	92 (11)